Winter Rapeseed Evaluations in North Dakota

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Introduction

Production risk with winter annual crops especially in regions with severe winters include poor spring stands due to winter-kill. Previous evaluations of winter rapeseed (*Brassica napus* L.) in North Dakota during the mid 1980s indicated inadequate winter-hardiness and essentially zero plant survival. However, more recently developed cultivars offer greater winter-hardiness and the potential for good crop performance from over-wintering stands.

Objective

The study objective was to evaluate current winter rapeseed winter-hardiness in eastern North Dakota.

Materials and Methods

Twenty winter rapeseed genotypes provided by Dr. C. Rife at Kansas State Univ. were evaluated in east central North Dakota near Prosper, an off-station site associated with the North Dakota Agricultural Experiment Station at Fargo. The Prosper site is located in the Red River Valley and is approximately 16 km north and 16 km west of Fargo. The experimental design was a RCB with three replicates. Treatments were winter rapeseed genotypes and a hybrid glyphosate tolerant spring canola cultivar Hyola 357 for comparison. Winter genotypes were sown at 7.3 kg ha^{-1} on 28 Aug. 2003 into standing hard red spring wheat (*Triticum aestivum* L.) stubble approximately 25 cm in height. The spring canola cultivar was sown at 7.3 kg ha^{-1} on two dates, 13 April and 17 May 2004, into standing wheat stubble.

Each plot consisted of 6 rows spaced 15 cm apart and 7.6 m in length. Data was determined from plants in the four center rows. Characters evaluated were fall stand, winter survival, spring stand, first flower, end flower, flower duration, and seed yield (Table 1). Dry nitrogen fertilizer as urea was top-dressed on 14 April 2004 to bring nitrogen fertility in the upper 60 cm of the soil profile to 180 kg ha^{-1}. Weed control was achieved by hand-weeding and insect control was not required.

Plant stands were swathed at physiological maturity of the upper pods (Berglund, 1998). Swaths dried approximately 10 d and were then threshed in field with a Hege 125 B plot combine. Standard data analysis, ANOVA, was performed by SAS for seed yield. Character means separation was performed by *F*-protected LSD comparisons at *P*<=0.05.

Table 1. Characters evaluated for the winter rapeseed genotypes and spring canola cultivar grown at Prosper, ND during 2003/2004.

Fall stand	Visual rating from 0 to 10 of established plant stands, where 10 is excellent and 0 is no stand
Winter survival	Percent of established plants that survived the winter and resumed growth in the spring
Spring stand	Fall stand multiplied by winter survival
First flower	Date 10% of plants have one or more open flowers
End flower	Date 90% of plants are done flowering
Flower duration	Days between first flower and end flower
Seed yield	Weight of harvested seed from each plot expressed in kg ha^{-1}

Results and Discussion

Although 20 genotypes were sown only 14 genotypes had replicated data for all characters evaluated in the ANOVA. Lack of replicated data was due to lodged stubble at the western side of the replicates that reduced fall stands, winter survival, and subsequent spring stands.

Mean winter rapeseed fall stands ranged from 4.2 to 6.2, winter survival from 47 to 91% and spring stands ranged from 2.0 to 5.6 (Table 2). First flower averaged 21 d earlier for the winter rapeseed genotypes compared to the early seeded canola cultivar. Flowering of the winter rapeseed genotypes was completed when the late sown spring canola cultivar began to flower. Flowering duration was approximately 4 and 9 d longer for the winter rapeseed genotypes compared to the early and late sown, respectively, spring canola cultivar. Earlier flowering of the winter genotypes compared to the early or late seeded spring canola cultivar enabled seed development to occur during a cooler period of the growing season resulting in less moisture and heat stress for the winter genotypes than the spring canola cultivar.

Although winter genotype spring stands ranged from 24 to 66% of the spring canola stands eight winter genotypes yielded equal to the early sown spring canola cultivar and seven genotypes yielded more than the late sown spring canola cultivar (Table 2). Yield performance from the low winter rapeseed spring stands is impressive since the minimum stands acceptable before replanting spring canola are 25% (Peel and Endres, 1997). Minimum crop stands and replanted stands generally produce lower yield than full stands sown at proper dates. The winter rapeseed plants became highly branched at the low stand densities and produced more pods per plant compared to the spring canola plants grown at higher stand densities. In this study, rapeseed exhibited high elasticity in yield component compensation to maintain yield. This was likely benefited by reproductive development occurring early in the growing season.

Table 2. Genotype means for evaluated characters for winter rapeseed/spring canola

grown at Prosper, ND during the 2003/2004 growing season.

Genotype†	Type‡	Fall Stand	Winter survival	Spring stand	First flower	End flower	Flower duration	Yield
			%				d	kg ha^{-1}
KS2002	W	4.3	47	2.0	5/24	6/30	37	1580
KS3021	W	4.2	54	2.3	5/25	6/26	32	2080
KS2004	W	4.3	61	2.6	5/24	6/21	28	1910
RWN215	W	6.0	61	3.7	5/23	6/26	34	1390
KS3022	W	4.3	65	2.8	5/24	6/22	29	2130
KS3011	W	4.2	67	2.8	5/24	6/20	27	2330
KS2002-MT	W	4.2	70	2.9	5/24	6/20	27	1520
KS3003	W	4.7	78	3.7	5/24	6/18	25	2140
KS3017	W	4.8	80	3.8	5/24	6/25	32	2160
KS3020	W	4.5	82	3.7	5/24	6/26	33	2020
KS3018	W	5.8	83	4.8	5/23	6/23	31	2160
Banjo	W	5.2	84	4.4	5/22	6/23	32	2620
KS9866-61aM	W	4.3	85	3.7	5/24	6/20	27	2400

RWN215-MT	W	6.2	91	5.6	5/23	6/28	36	1880
H357 early	S	-	-	8.5	6/10	7/7	27	2440
H357 late	S	-	-	8.5	6/30	7/22	22	1760
LSD (0.05)								370

†Six genotypes lacked replicated character observations and were not included in the analysis.

‡W-winter rapeseed; S-spring canola

Summary

Current rapeseed winter-hardiness is substantially greater with survival ranging from 47 to 91% as compared to essentially zero survival of genotypes evaluated 20 years ago. Although most winter genotype stands were near the replanting level for spring canola the winter rapeseed yields were often equal to the early sown spring canola cultivar and in many instances greater than the late sown spring canola cultivar. This indicates lower minimum stands may be acceptable before replanting winter rapeseed than those acceptable for spring canola. As stand density becomes lower the importance of stand uniformity becomes increasingly important.

Additional plant breeding improvement in rapeseed winter-hardiness and determination of optimum stand establishment factors are needed before winter rapeseed production in North Dakota is commercialized.

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References

Berglund, D.R. 1998. Canola production. NDSU Ext. Serv. Bull. A-686 (revised)

Peel, M.D., and G. Endres. 1997. Replanting after early season crop injury. NDSU Ext. Serv. Bull. A-934 (revised)